

## Stock theft control mechanism and economic impact of livestock theft in the Free State Province of South Africa: Implication for agricultural management policies

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### ABSTRACT

The aim of the study was to estimate the financial impact (direct and indirect costs) of livestock theft and to identify different methods farmers used to control stock theft in the Free State Province of South Africa. The study used primary data collected from 292 commercial livestock farmers from the five municipalities of the Free State province. The direct and indirect cost of livestock theft rate was significant and mostly a higher level of management led to lower livestock theft losses. Livestock theft should be controlled successfully in order to sustain the South African livestock industry and competitiveness. The study recommends that there should be coordination and collaboration among all key role players in the industry including government institutions, the South African Police Service, agricultural businesses or organisations, farmer's unions and stock theft units. The role players should target, eradicate or reduce stock theft and encourage controlling mechanisms in order to enhance food security, sustain livestock competitiveness and achieve sustainable development goals by reducing hunger and poverty.

**KEYWORDS:** Direct cost; indirect cost; livestock theft; control stock theft; South Africa

### 1. Introduction

Some consider that livestock theft is as old as farming itself and is nothing new to farmers (Clack, 2013). Producers in all South African provinces are victims of stock theft. Both the commercial and emerging farming sectors are affected and statistics show that the occurrence of stock theft has increased over the years (PMG, 2010). With regard to certain livestock theft cases, it seems that more thieves make use of firearms and that theft has been commercialised with crime syndicates stealing larger numbers of animals at a time. This trend can be one of the contributing factors as to why more farmers are leaving the livestock industry, thus placing more pressure on South Africa's food security (PMG, 2010).

The annual economic impact of livestock theft in South Africa was reported at R 878 million<sup>3</sup> (Clack, 2018). Worse still, is that official statistics are underestimated (Scholtz and Bester, 2010; Clack, 2013). While available literature

has investigated the number of animals lost (direct costs), no scientific investigation has focused on which loss-controlling practices farmers use and the cost of these practices (indirect cost).

In South Africa, extensive livestock farming is the primary farming activity suitable for 80 percent of the farmland (DAFF, 2012). Regardless of the seriousness of the problem, little research has been done to determine the methods used and actions taken by farmers to control stock theft as well as the effectiveness of these methods. Research investigating these control methods, actions taken and the economic impact of livestock theft in South Africa is a critical issue and requires major support. Such research will be beneficial for the livestock industries of South Africa. Due to the official livestock statistics being underestimated, it is of the utmost importance that the true impact of livestock theft in South Africa is investigated. Once the true impact and the methods used to control livestock theft is known, the total economic impact

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<sup>3</sup> R is Rand (South African currency); 1US\$ = R14.84 on 10 June 2019.

thereof can be calculated. The total economic impact consists of the direct cost (cost of animals lost) and the indirect cost (cost of methods used and actions taken).

Most existing international and African studies (Donnermeyer and Barclay, 2005; Kynoch and Ulicki, 2010; Clack, 2013; Sidebottom, 2013; Clack, 2015; Manu *et al.*, 2014; Doorewaard *et al.*, 2015; Maluleke *et al.*, 2016) focus on the extent and type of livestock stolen. These studies include the extent of stock theft by focusing on the number of cases reported. Additionally, the studies investigate whether livestock theft patterns reflect variations in the extent to which different animals are concealable, removable, available, valuable, enjoyable, and disposable preference to steal. Also, these authors compiled literature based on the impact of stock theft, the uniqueness of livestock theft, case studies where individuals have been found guilty of livestock theft, examined the situation of policing in relation to the crime committed against agricultural operations, determined the causes of cattle theft and indicators for stock theft in rural areas. Yet research on the extent of economic impact (direct and indirect costs) of stock theft, which includes methods farmers use to control and actions taken against stock theft, remain insufficient and limited. Therefore, the objective of this study was to estimate the true financial impact (direct and indirect cost) of livestock theft and to identify different methods farmers used to control stock theft in the Free State Province of South Africa.

## 2. Materials and Methods

The Free State Province of South Africa, which is the focus of this study, is situated centrally within South African borders. The Free State Province consists of five municipalities namely, Fezile Dabi, Lejweleputswa, Mangaung metropolitan, Thabo Mofutsanyane and Xhariep (Figure 1). The province does not only share its border with six other provinces, but also with Lesotho. Lesotho, also known as the Mountain Kingdom, is completely surrounded by South Africa (Lesotho, 2015). The border shared between the Free State Province and Lesotho is 450 km long and is guarded by 100 troops of the South African National Defence Force (Steinberg, 2005). The Free State Province has a population of 2 745 590 (Statistics South Africa, 2011) with roughly 54 000 people employed in the agricultural sector (Statistics South Africa, 2014). Mangaung had the highest population density of the five municipalities based on its small size and large population (747 431). The second largest population per municipality was Thabo Mofutsanyane (736 238). Even though the Xhariep is relatively large it had the only housed the smallest population (146 259) of the five municipalities (Statistics South Africa, 2011).

According to the Department of Agriculture, Forestry and Fisheries (DAFF), there are 6 065 commercial livestock farming units in the Free State Province (DAFF, 2013). The province has a total size of 12 943 700 ha, of which 90.9% is used for farming. Commercial farmers have approximately 11.5 million hectares of land at their disposal and emerging farmers almost 323 thousand hectares (DAFF, 2013). Grazing land, which is mainly suitable for livestock farming, makes up 58.1% of commercial farmland and 66% of emerging farmland (DAFF, 2013).

The Free State Province has the third largest number of sheep as well as cattle, estimated at approximately 4.8 million sheep and 2.3 million cattle. The province also houses 230 thousand goats (DAFF, 2014a). The Xhariep municipality houses the largest percentage of the Free State Province's sheep at approximately 41% and the Mangaung municipality houses only approximately 1% (DAFF, 2014a). When investigating the distribution of cattle in the Free State province, one notices that the Thabo Mofutsanyane municipality houses the largest portion (36%) of the province's cattle, the Fezile Dabi municipality houses the second largest (30%) and the Mangaung municipality houses the smallest (2%) portion (DAFF, 2014a). The largest portion of the Free State province's goats (41%) is housed in the Lejweleputswa municipality with the Xhariep municipality housing the second largest portion (40%) and the Mangaung municipality housing smallest portion (3%) (DAFF, 2014a). Carrying capacity differs dramatically throughout the province from 3.5 ha per large stock unit (LSU) in the East to 16 ha/LSU in the West (DAFF, 2014b).

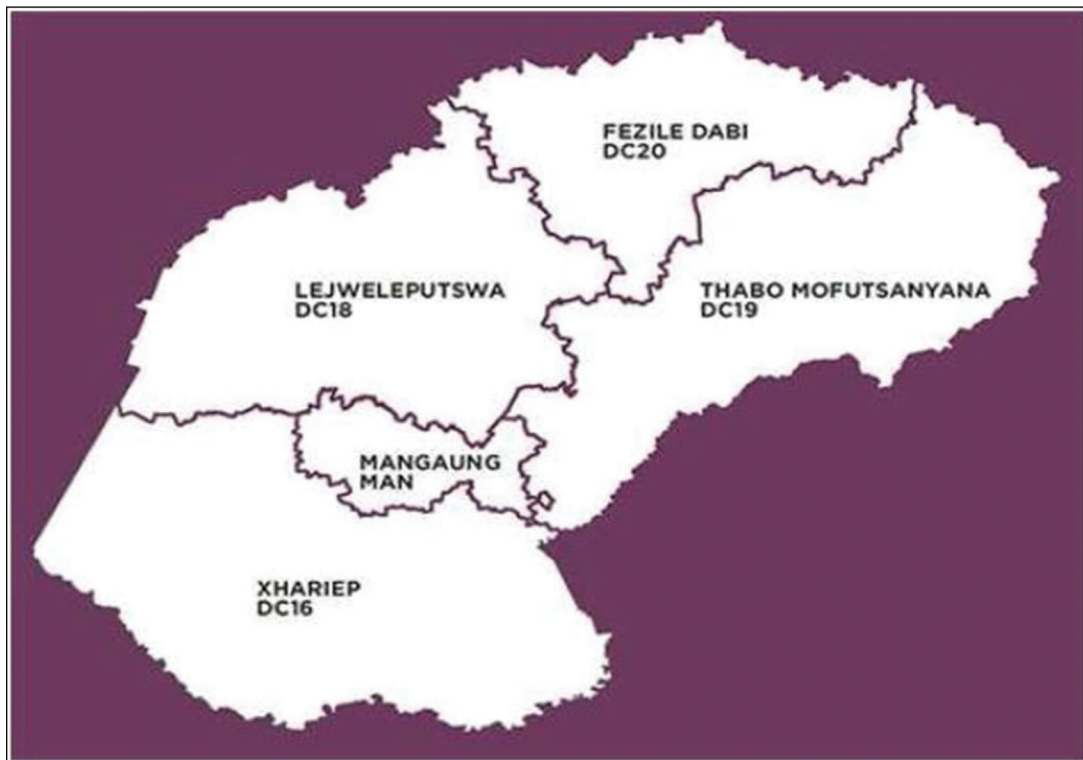
The Free State province was selected, because it primarily consists of grazing land suitable for livestock farming (cattle, sheep, and goats). The Red Meat Producers Organization (RPO) of the Free State Province provided a data set from which the contact details of approximately 2 500 commercial livestock farmers could be sourced. This ensured that only commercial livestock farmers were interviewed. Primary data were collected using a semi-structured questionnaire from 292 livestock farmers over a four-month period (May – August 2014). An appropriate sample size of 292 respondents were selected using the formula developed by Cochran (1977), which was representative of the livestock farmers in the Free State province (Diamond, 2001).

A stratified random sampling process was applied to livestock farmers within five municipalities according to their farm's demographic and topographic location. This allowed for comparison and correlation between the different municipalities and that only livestock farmers were interviewed. The number of livestock farmers within the five municipalities comprised Xhariep (45), Lejweleputswa (72), Thabo Mofutsanyane (97), Fezile Dabi (61) and Mangaung (17). The proportion of livestock in each municipalities determined the respective sample sizes. The questionnaire was administered to the respondents during telephonic interviews. The questionnaire contained questions regarding farmers' years of farming, age, farm size, farm location and farm topography, losses due to livestock theft and practices used to control livestock theft (methods used, actions taken, how often these practices were performed and the annual cost of these practices). Table 1 provides an overview of the number of respondents and livestock surveyed in each of the municipalities.

As indicated in Table 1, 292 respondents<sup>4</sup> were interviewed and represented 4.81% of the 6 065 livestock farmers in the province (DAFF, 2013). The data represented 159 081 sheep (3.31%), 77 675 cattle (3.48%), 8 277 goats (3.61%) and 604 393 ha (5.22%) of land in the province.

Data on sheep per municipality as a percentage of the total in the province, Xhariep represent the largest (1.40%) and Thabo Mofutsanyane the second largest

<sup>4</sup> Each participant was from a separate farming operation.



**Figure 1:** Municipalities of the Free State Province. Source: The Local Government Handbook (2015).

percentage (0.94%). As in the case of sheep, there was a large variation in the number of cattle between the municipalities. Thabo Mofutsanyane (808 984) had the largest and Fezile Dabi (671 481) the second largest number of cattle. In the Thabo Mofutsanyane, the data for 33 216 cattle were captured and represented approximately 1.49% of the cattle in Free State Province. In total, the data captured in this study represented approximately 91 831 head of cattle, which was roughly 4.11% of the cattle in the Free State Province. Lejweleputswa had the largest number of goats (8 554 goats or 3.74%) in the Free State Province, which was contrary to the case of cattle and sheep.

The survey data were processed to estimate the financial impact (direct cost and indirect cost) of livestock theft in the Free State Province and to determine the different methods and actions farmers are used to control stock theft in different municipalities. Prior to the estimation, summary statistics of the farmers were collected to give an overview of the socio-economic characteristics of respondents. The questionnaire was used to identify livestock theft control practices and the percentage of farmers using each method. Livestock theft control practices comprised the method used and the action taken to combat livestock theft. The method used included management practices, physical barriers, animals, and technology. Actions taken includes night patrols and access control.

To estimate the financial impact (direct cost and indirect cost) of livestock theft, quantification of the direct cost consisted of two calculations. Firstly, the total number of livestock lost annually per municipality was calculated:

$$L = R \times S \tag{1}$$

Where *R* represents the annual loss rate per municipality (%), *S* represents the total number of livestock (cattle, sheep, and goats) per municipality and *L* represents the total number of livestock lost annually per municipality.

Secondly, the livestock lost annually per municipality (five municipalities) was added to calculate the total number of livestock lost annually. Once the total losses were determined, the monetary value of the losses were calculated as:

$$C = L \times P \tag{2}$$

Where *L* represents the total number of livestock lost, *P* represents the unit cost per animal (sheep, cattle, and goats respectively) and *C* represents the total annual direct cost of livestock theft in the Free State Province. These calculations were separated for cattle, sheep, and goats.

The annual loss rate was calculated by taking the number of animals stolen and deducting number of animals retrieved (not recovered by the police or by the farmers). This number was divided by the number of animals represented in the survey and expressed as a percentage. To assign a monetary value to animal loss is complex, however, the National Livestock Theft Forum decided on a value of R 10 400 per head cattle, R1 700 per sheep and R 1 950 per goat during the RPO national congress in 2012 (RPO, 2012). This estimated value was used in this study.

The indirect costs represented all of the expenses incurred in an attempt to control/lower livestock theft. Indirect costs were calculated as:

$$K = M/N \times 100 \tag{3}$$

Where *K* represents the total annual cost of control practices and methods per municipality in the Free State, *M* represents the total annual cost of control practices

**Table 1:** Number of respondents and livestock represented in the study area

Variable	Number of farmers interviewed, hectare of farm land and number of livestock in Free State		Interviewed		Percentage	
	Number					
Farming units	6 065		292		4.81	
Sheep	4 806 386		159 081		3.31	
Cattle	2 233 784		77 675		3.48	
Goat	229 229		8 277		3.61	
Farmland (ha)	11 572 000		604 618		5.22	

Municipalities	Respondents No.	Hectare in the survey (ha)	Number of farmers interviewed in the municipalities			% surveyed per municipality				
			No. Surveyed			No. in the province				
			Sheep	Cattle	Goat	Sheep	Cattle	Goat		
Xhariep	45	148 818	67 101	8 570	3 137	1 960 874	91 677	1.40	3.42	3.42
Lejweleputswa	72	140 798	8 941	16 057	3 328	290 770	450 339	0.19	3.57	3.57
Thabo Mofutsanyane	97	180 967	45 039	33 216	982	1 096 944	808 984	0.94	4.11	4.11
Fezile Dabi	61	180 967	34 694	30 204	591	1 451 900	671 481	0.71	4.50	4.50
Mangaung	17	31 581	3 306	3 784	516	45 898	7 170	0.07	7.20	7.20
Total	292	604 393	159 081	91 831	8 554	4 806 386	2 233 784	3.31	3.48	3.61

Stock theft control mechanism and Stock theft impact and methods per municipality and  $N$  represents the percentage of livestock represented per municipality.

### 3. Result and Discussion

Table 2 illustrates a summary of socio-economic characteristics of the respondents. The average age of the respondents was 51 years. This finding concurred with that of Badenhorst (2014) where fewer young people considered a career in agriculture. Years of farming experience was on average 25 years, which corresponds to the average farmers' age of 51 years.

Full-time farmers (Table 2) accounted for 86.30% of the respondents. On average, 32 sheep were stolen from each farmer over the data collection period with a maximum of 600 sheep being stolen. Many farmers, however, lost no sheep. A great problem is that on average only 5 sheep were retrieved per farmer. Thus, on average 27 sheep were lost per farmer. An average of 5 cattle were stolen from each farmer with the average recovery of 1 head of cattle per farmer. As in the case of sheep, some farmers did not experience any cattle theft during the study with a maximum of 87 cattle stolen from a farmer. On average, 1 goat was stolen per farmer during the study with a maximum of 76 goats stolen from a single farmer. The average number of goats recovered per farmer was 0.02.

Each farmer employed an average of 7 farm workers. Most farmers (93.5%) indicated that they took copies of employees' identification documents (ID) and checked new employees' criminal history (87%) at their local police station. This had an implication for a lower rate of stock theft incidences. The average size of the farming unit was 2 070 ha and the average distance of the farms from the nearest town was 21 km.

The annual livestock stock theft rate, loss rate and recovery rate calculated from the survey data is shown in Table 3. Lejweleputswa had the highest sheep theft rate (6.78%) and Xhariep the lowest (1.07%). Similar to the sheep theft rate, Lejweleputswa had the highest sheep loss rate (5.98%) and Xhariep the lowest (0.96%). Mangaung had the highest sheep recovery rate (15.83%) and Fezile Dabi the lowest (4.27%).

The highest cattle theft rate (Table 3) was experienced in Lejweleputswa (0.79%) with the Thabo Mofutsanyane in second place (0.64%). The annual recovery rate for cattle was higher in all the municipalities compared to the recovery of sheep. The highest recovery rate for cattle was in Lejweleputswa (27.56%) with Fezile Dabi (23.81%) in second place. When comparing the loss rate of cattle to that of sheep it was clear that the theft of sheep was much higher. Despite the high recovery rate for cattle in Lejweleputswa, this municipality experienced the highest cattle theft loss rate (0.57%) with the Thabo Mofutsanyane a close second (0.56%). Xhariep experienced the highest annual loss rate of goats (1.12%) and was the highest annual theft rate for the five municipalities. Fezile Dabi had the second-highest loss rate (0.34%) with Thabo Mofutsanyane in third place (0.31%).

The annual loss rates (Table 3) were used to calculate the direct cost of livestock theft in the Free State Province. The number of sheep, cattle, and goats used is an estimate was provided by the Department of Agriculture, Fisheries and Forestry for commercial farmers only (DAFF, 2014a). The monetary value of R1 700 per

**Table 2:** Summary of the respondents' socio-economic characteristics (n = 292)

Characteristic	Average	Minimum	Maximum	Standard deviation
Age of respondent (years)	51.16	20	84	13.02
Years farming	24.58	1	68	13.84
Full-time farmer (%)	86.30	-	-	-
Number of sheep stolen per farmer	32.45	0	600	63.57
Number of sheep recovered per farmer	5.24	0	222	23.85
Number of cattle stolen per farmer	4.86	0	87	12.20
Number of cattle recovered per farmer	0.94	0	47	4.81
Number of goats stolen per farmer	0.43	0	76	4.78
Number of goats recovered per farmer	0.02	0	5	0.29
Number of employees	7.03	0	45	6.76
Take ID copy (%)	93.5	-	-	-
Check employee's history (%)	87	-	-	-
Size of farm (ha)	2 070.61	50	12 000	2 111.91
Distance from town (km)	21.26	0	60	10.79
Distance from informal settlement (km)	20.81	0.9	60	10.49

sheep, R 10 400 per head of cattle and R 1 950 per goat was used as the market value of the animals (RPO, 2012) and served as a base price for this study. Note that this price can be changed for future calculations.

The direct costs of livestock theft in the Free State Province of South Africa are shown in Table 4. The annual direct financial impact of sheep theft in Free State Province is estimated at approximately R144 million. It was estimated that 84 955 (1.76 % of the total sheep population in the province) sheep are annually lost to stock theft in the Free State Province. Thabo Mofutsanyane experienced the largest direct annual loss (R43 076 300) to livestock theft of all the municipalities and Mangaung had the smallest annual financial loss (R2 386 800). Even though Lejweleputswa had the highest loss rate, the small number of sheep in the municipality led to low direct annual losses.

Thabo Mofutsanyane experienced the second highest cattle loss rate (0.56%) and the largest annual cattle losses (4 530) of the five municipalities (Table 4). Although the loss rate was slightly less than that of the Lejweleputswa (0.57%), the large number of cattle caused the highest number of cattle losses. Notice that the losses in Thabo Mofutsanyane were almost double that of the municipality in second place, namely Lejweleputswa (2 567). The annual direct cost of cattle losses in the Free State Province was calculated to be slightly more than R 100 million.

Khariep recorded 1 027 goat losses per year (Table 4). This number was relatively high and was caused by the large number of goats as well as the high goat loss rate experienced in the municipality. The annual direct cost of goat theft was calculated to be roughly R 2.25 million.

It is clear that sheep theft contributed to the largest share of direct annual cost livestock theft. Although the value per head of cattle was much more than per sheep, the large number of sheep lost caused this large direct cost. The impact of goat theft was small compared to that of sheep and cattle. This was mainly because relatively small numbers of goats were housed in the Free State. Thabo Mofutsanyane experienced the largest annual direct cost of livestock theft in the Free State Province valued at roughly R 90 million (Table 4) with Fezile Dabi in second place at almost R64 million. The total annual direct cost of livestock theft in the Free State Province was calculated to be R 246 744 550.

The indirect cost represented the expenditure associated with practices used for controlling livestock theft. Once the indirect costs were known, the total cost of livestock theft in the Free State Province was calculated. The indirect cost of livestock theft (Table 5) showed that Thabo Mofutsanyane spent the largest amount of capital (R 16 861 172) on actions and methods to control stock theft. Fezile Dabi had the second largest annual indirect cost (R 15 910 488) and Lejweleputswa the third largest (R15 647 899). Notice how the magnitude of the indirect costs of each district corresponded to the magnitude of the direct cost of theft in each municipality. The municipalities that experienced larger losses spent larger amounts of money on actions and methods. This made sense since the more one loses the more effort will be put into controlling the losses. With regard to the Free State Province, the total annual indirect cost was calculated to be R 57 114 006. The total annual cost of livestock theft is represented in the last column of Table 5. The largest total annual cost was experienced in Thabo Mofutsanyane (R107 193 772), which was much higher than the value of Fezile Dabi, which was second (R79 814 238).

The total annual cost of livestock theft in the Free State Province was calculated to be R 303 858 556. This was an astonishingly high value and emphasized that livestock theft required serious attention.

The methods farmers currently used to control stock theft was grouped under either method used (Table 6) or actions taken (Table 7). Methods used included management practices, physical barriers, technology and animals. Management practices included guards, stock theft informants, strategic use of guards and strategic use of theft informants. Physical barriers included corral at night, electric fencing, locking gates, strategic corralling, and strategic electric fences. Technologies included stock theft collars, cameras, lights in the corral, alarms in the corral, strategic collars and strategic cameras. Animals included guard dogs, ostriches, black wildebeest, donkeys, strategic use of dogs.

Table 6 summarises the methods used to control livestock theft in the Free State Province. The use of control methods differed slightly between municipalities with corralling of sheep (actively and strategically<sup>5</sup>) being the

<sup>5</sup>Strategically refers to cases where action and methods are performed during known problematic livestock theft times of the year or month.

Table 3: Number of livestock stolen, recovered and lost in the Free State Province

Municipalities	No. Surveyed			No. stolen per year			No. recovered per year			No. lost per year		
	Sheep	Cattle	Goat	Sheep	Cattle	Goat	Sheep	Cattle	Goat	Sheep	Cattle	Goat
Xhariep	67 101	8 570	3 137	720	15	35	76	2	0	644	13	35
Lejweleputswa	8 941	16 057	3 328	606	127	2	71	35	1.67	535	92	0
Thabo Mofutsanyane	45 039	33 216	982	1 104	211	3	65	25	0	1 039	186	3
Fezile Dabi	34 694	30 204	591	609	126	2	26	30	0	583	96	2
Mangaung	3 306	3 784	516	120	0	0	19	0	0	101	0	0
Total	159 081	91 831	8 554	3 159	479	42	257	92	1.67	2 902	387	40
	Annual stock theft rate (%)=No. stolen per year/ No. Surveyed			Annual loss rate (%)=No. lost per year/ No. Surveyed			Annual recovery rate (%)=No. recovered per year/ No. stolen per year			Annual recovery rate (%)=No. recovered per year/ No. stolen per year		
Municipalities	Sheep			Sheep			Sheep			Sheep		
Xhariep	1.07	0.18	1.12	0.96	0.15	1.12	0.15	1.12	10.56	13.33	0.00	0.00
Lejweleputswa	6.78	0.79	0.06	5.98	0.57	0.00	0.57	0.00	11.72	27.56	83.50	0.00
Thabo Mofutsanyane	2.45	0.64	0.31	2.31	0.56	0.31	0.56	0.31	5.89	11.85	0.00	0.00
Fezile Dabi	1.76	0.42	0.34	1.68	0.32	0.34	0.32	0.34	4.27	23.81	0.00	0.00
Mangaung	3.63	0.00	0.00	3.06	0.00	0.00	0.00	0.00	15.83	0.00	0.00	0.00
Total	1.99	0.52	0.49	1.82	0.42	0.47	0.42	0.47	8.14	19.21	3.98	0.00

Table 4: The direct cost of livestock theft in the Free State Province

Municipalities	Annual loss rate (%)			No. livestock in the province			No. livestock lost annually = Annual loss rate * No. livestock in the province			Annual direct loss (R) = No. livestock lost annually * R1 700/R10 400/R1 950			Total annual direct cost (R) of livestock		
	Sheep	Cattle	Goat	Sheep	Cattle	Goat	Sheep	Cattle	Goat	Sheep	Cattle	Goat	Sheep	Cattle	Goat
Xhariep	0.96	0.15	1.12	1 960 874	250 443	91 677	18 824	376	1 027	32 000 800	3 910 400	2 002 650	37 913 850		
Lejweleputswa	5.98	0.57	0.00	250 770	450 339	93 333	14 996	2 567	9	25 493 200	26 696 800	17 550	52 207 550		
Thabo Mofutsanyane	2.31	0.56	0.31	1 096 944	808 984	23 915	25 339	4 530	74	43 076 300	47 112 000	144 300	90 332 600		
Fezile Dabi	1.68	0.32	0.34	1 451 900	671 481	13 134	24 392	2 149	45	41 466 400	22 349 600	87 750	63 903 750		
Mangaung	3.06	0.00	0.00	45 898	52 537	7 170	1 404	0	0	2 386 800	0	0	2 386 800		
Total	1.82	0.42	0.47	4 806 386	2 233 784	229 229	84 955	9 622	1 155	144 423 500	100 068 800	2 252 250	246 744 550		

most popular method in all municipalities. In Lejweleputswa, 75% of the farmers corralled their sheep at night (actively and strategically) while in Fezile Dabi, less than 28% of the farmers corralled their sheep at night (actively and strategically).

Besides corraling animals at night, Xhariep data indicated that dogs (active and strategic) were the preferred control method (24.44%). This was also the case in Lejweleputswa where approximately 21% of farmers used dogs as a control method (active and strategic). In Thabo Mofutsanyane, the second most method used was guards (actively and strategically) at 14.43%. Stock theft collars (actively and strategically) proved to be the second most used control method in Fezile Dabi (18.03%).

**Table 5:** The indirect and total cost of livestock theft in the Free State Province

Municipalities	Total annual direct cost of livestock theft according to the study (R)	Total annual indirect cost of livestock theft according to the survey (R)	Total annual cost according to survey (R)
Xhariep	37 913 850	7 538 007	45 451 857
Lejweleputswa	52 207 550	15 647 899	67 855 449
Thabo Mofutsanyane	90 332 600	16 861 172	107 193 772
Fezile Dabi	63 903 750	15 910 488	79 814 238
Mangaung	2 386 800	1 156 441	3 543 241
Total	246 744 550	57 114 006	303 858 556

In Mangaung, two methods came in second place, guards (11.76%) and lights in the corral (11.76%).

Taking into account the Free State Province as a whole, the leading method that farmers used to control livestock theft was corraling animals at night. More than 33% of the farmers actively corralled their sheep at night. Approximately 14% of farmers strategically corralled their sheep during known problematic times of the year. Surprisingly though, one farmer specifically indicated that he experienced more livestock theft since he started corraling his animals, because it was easier to catch them in a confined area. The use of a guard was the second preferred method (10% active and 3% strategic). When combining the use of dogs (active and strategic), more than 13.6% of the farmers used guard dogs. It is interesting to note that approximately 10% of the farmers used stock theft collars (active and strategic), 8.2% used cameras (active or strategic) and 3.4% of the farmers used alarms. It seemed that the use of technology was taking place in farming, specifically in the livestock industry, which strived to solve problems with technological answers.

The actions taken against livestock theft represented activities where livestock farmers were directly involved. Actions taken against stock theft included active patrolling, access control, strategic use of patrols, strategic use of access control, count daily, count more than once per day, count once a week, count more than once a week, count monthly, farmers' union patrols, neighbourhood watch patrols, private company patrols. Keep in mind that in some cases farmers only used control methods/actions during problematic times of the year (e.g., Christmas and Easter weekends), which tended to have

**Table 6:** Methods used to control livestock thefts (%)

	Xhariep	Lejweleputswa	Thabo Mofutsanyane	Fezile Dabi	Mangaung	Free State
<b>Management practices</b>						
Guards	11.11	11.11	10.31	8.20	11.76	10.27
Strategic guard	2.22	2.78	4.12	1.64	0.00	2.74
Theft informant	2.22	0.00	3.09	1.64	0.00	1.71
Strategic theft informant	2.22	4.17	7.22	6.56	0.00	5.14
<b>Physical barriers</b>						
Corral at night	17.78	51.39	35.05	21.31	29.41	33.22
Strategic corraling	11.11	23.61	11.34	6.56	23.53	14.04
Lock gates	0.00	0.00	3.09	0.00	0.00	1.03
Electric fencing	0.00	6.94	5.15	3.28	0.00	4.11
Strategic electric fences	2.22	2.78	0.00	0.00	0.00	1.03
<b>Technology used</b>						
Lights in corral	0.00	0.00	2.06	0.00	11.76	1.37
Alarm in corral	2.22	4.17	5.15	0.00	5.88	3.42
Camera	11.11	9.72	3.09	1.64	5.88	5.82
Strategic camera	4.44	2.78	2.06	1.64	0.00	2.40
Stock theft collar	6.67	6.94	4.12	13.11	5.88	7.19
Strategic stock theft collar	2.22	2.78	3.09	4.92	0.00	3.08
<b>Animals used</b>						
Ostrich	6.67	1.39	1.03	0.00	0.00	1.71
Donkey	2.22	5.56	5.15	4.92	0.00	4.45
Wildebeest	2.22	0.00	1.03	0.00	0.00	0.68
Dogs	11.11	16.67	10.31	0.00	0.00	9.25
Strategic dogs	13.33	4.17	3.09	1.64	0.00	4.45

**Table 7:** Actions taken to control livestock theft (%)

	Xhariep	Lejweleputswa	Thabo Mofutsanyane	Fezile Dabi	Mangaung	Free State
Active patrols	60.00	38.89	52.58	39.34	58.82	47.95
Access control	31.11	9.72	23.71	16.39	23.53	19.86
Strategic patrols	6.67	19.44	10.31	29.51	0.00	15.41
Strategic access control	15.56	11.11	11.34	19.67	0.00	13.01
Count daily	24.44	58.33	54.64	42.62	70.59	49.32
Count more than once per day	2.22	1.39	3.09	3.28	0.00	2.40
Count once per week	40.00	33.33	37.11	31.15	17.65	34.25
Count more than once per week	31.11	13.89	15.46	26.23	17.65	19.86
Count monthly	8.89	5.56	2.06	1.64	5.88	4.11

higher livestock theft occurrence. In these cases, actions were specified as strategic actions.

The actions farmers took to control livestock theft in the Free State Province are shown in Table 7. In all of the municipalities, patrols were preferred, followed by access control. In four of the five municipalities, most farmers counted their livestock on a daily basis. However, in Xhariep, most farmers indicated that they counted livestock once a week. Almost half (48%) the farmers actively patrolled and more than 15% strategically patrolled during problematic times of the year (Christmas and Easter weekends). Approximately 20% of the farmers actively used access control a further 13% strategically used access control. It was good to note that almost 52% of the farmers counted their animals on a daily basis, with 3% of these farmers counting more than once a day. Approximately 20% of the farmers did not count on a daily basis, but more than once a week. Approximately 34% of the farmers counted their animals on a weekly basis, but a disturbing number of farmers (4%) only counted once a month. With regard to counting animals, it seemed as if most of the farmers were willing to put in extra effort to control livestock theft and ensure early detection of stolen animals. However, there were still individuals who might detect animal theft too late to act. It should be taken into account that it is not always possible for a farmer to count animals on a daily basis, because of the time required for other farm enterprises. For example, during the planting season of maize, farmers have little time to attend to livestock requirements. It is also possible that the livestock is kept in an isolated area and can only be counted on a weekly basis.

#### 4. Conclusion and Recommendations

The objective of the study was to estimate the financial impact (direct cost and indirect cost) of livestock theft and to identify different methods farmers used to control stock theft in the Free State Province of South Africa. The total annual cost of livestock theft in the Free State Province was estimated to be R 303 858 556. Of this amount, the direct cost of stock theft was R 246 744 550 while indirect costs contributed a further R57 114 006. The results suggested that higher levels of losses led to higher levels of expenditure to combat stock theft (indirect cost). However, in some parts of the study area, minimal control practices (action or method) were applied to control livestock theft.

Farmers are recommended to report stock theft cases as soon as they become aware of them. By not reporting,

farmers do more damage to the industry than good. When stolen animals are reported as soon as possible, will ensure maximum time for the police and stock theft units to react, thus maximising the possibility of successful retrieval of animals. Farmers' unions and the police or stock theft units should form reaction teams, which can immediately act on suspicious activity and stock theft cases. It is recommended that support should be provided to livestock farmers by government institutions, the South African Police Service and other agricultural businesses or organizations. Farmers' unions and the police or stock theft units should work together to reduce the direct and indirect cost of livestock theft. If livestock theft is not successfully controlled, it will not only threaten the sustainability of the South African livestock industry, but also the competitiveness of the industry. It is also, recommended that livestock farmers especially (sheep farmers) count their livestock on a daily basis. If the farmer is unable to count the livestock every day, a trusted herdsman or farm manager should be entrusted with the duty.

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#### Declaration and Statement

We declare that this work is an original academic research carried out by the authors and we confirm that the manuscript has not been submitted elsewhere and is not under consideration by another journal. There are no conflicts of interest.

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